(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 889 252 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.01.1999 Bulletin 1999/01

(51) Int. Cl.6: F16C 3/02

Y 3

(21) Application number: 98109610.0

(22) Date of filing: 27.05.1998

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 02.07.1997 DE 29711559 U = D2

(71) Applicant: Howmedica GmbH
D-24232 Schönkirchen (DE)

(72) Inventors:
- Harder, Hans Erich
  24253 Probsteierhagen (DE)
- Jensen, Harm-Iven
  24214 Noer (DE)
- Speitling, Andreas Werner, Dr.-Ing.
  24105 Kiel (DE)

(74) Representative:
Patentanwälte
Hauck, Graalfs, Wehnert,
Döring, Siemons
Neuer Wall 41
20354 Hamburg (DE)

(54) An elongate element for transmitting forces

(57) A hollow elongate element (2) of elastic material for transmitting forces in which the wall (4) comprises openings (6) which reduce the bending resistance moment and are arranged such that the torsion resistance moment of the element essentially remains.

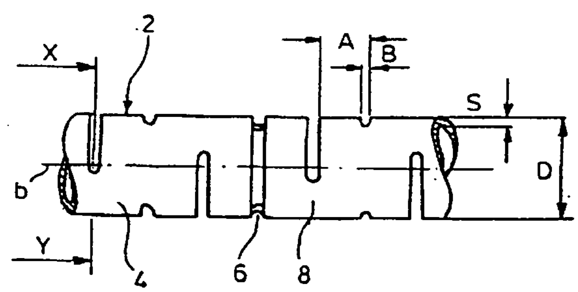

FIG. 1

EP 0 889 252 A2

Description

The invention relates to an elongate element for transmitting forces, according to claim 1.

In mechanics as is known elements are used for force transmission whose structure, shape and mounting, in addition to force transmission also effect "flexibility" (elastic deformability) in various combinations of the spacial degrees of freedom. For example a cable transmits tensile force (as a rubber cable or rubber band in an elastic manner) but not compressive force, transverse force, torsion and bending moments. A rigid beam on the other hand transmits all known forces and moments, but however with respect to the cable does not for example offer the free deformability transversely to the extension direction, thus offer e.g. the possibility of changing the transmitted tensile force in its direction by way of redirecting via a roller.

Elongate elements for transmitting forces in technical systems are used in a static or dynamic function: a shaft for example is per se a rotating, thus dynamically applied elongate element for transmitting torsional force. The already mentioned beam as part of a rod framework, for example in a scaffolding, is a statically applied elongate element which in particular transmits tensile and compressive force, but also accommodates bending moments in order to prevent buckling.

Known elongate elements for transmitting forces in various spacial directions are essentially completely rigid or "slack", but only in a few embodiment forms are of a certain desired flexibility or elasticity (stiffness). Examples of this are the rubber cable already mentioned, which in its longitudinal direction has a certain rubber elasticity and in all other directions is slack. A further example is a so-called bending shaft which elastically accommodates bending moments about any axis perpendicular to its longitudinal axis and transmits torsion force about its longitudinal axis essentially rigidly. Bendable shafts are usually wound from wire and may be coated in order to keep the wire winding in its shape. In order to transmit torsional forces in both directions, it usually requires second oppositely wound wire layers. Such bendable shafts are accordingly manufactured from several parts, but are therefore expensive in their manufacture and furthermore are of a relatively small load capacity and life expectancy.

It is the object of the present invention to provide an elongate element for transmitting forces which is elastically bendable perpendicular to its longitudinal axis at least about one axis, and which is improved with respect to its technical characteristics.

This object is achieved in the present invention by the features formulated in claim 1.

With the present invention a hollow elongate element for transmitting forces is of elastic material. The walling of the elongate element comprises openings in an arrangement which reduce the bending resistance moment of the element. The openings in the walling of the element are arranged such that the torsion resistance moment of the element remains essentially unchanged. The element may be cylindrical, preferably tubular. It permits as a one-piece design element a simple manufacture. It requires no lubrication or regular maintenance since there are no different parts which are mounted to one another or rub against one another.

The openings may be arranged in a pattern recurrent in the longitudinal direction of the element. This is preferably spiral-shaped.

A preferred embodiment form of the invention provides slots as openings which in each case extend transversally into the elongate element. The element with a cylindrical, preferably tubular cross section is transversally notched by each slot, wherein a region near to the edge, preferably a region of the tube walling of each notched cross section is not cut through by the slot. The slots are so displaced in the circumferential direction that the regions which are not cut through are arranged in the longitudinal direction of the element in a helical manner.

In this manner the bending resistance moment of the element firstly is in each individually notched segment considerably reduced in that each slot does not cut through only one web of the tube walling. The width of the slot dependent of the depth of the slot is preferably formed larger than the tubular wall thickness. The bending resistance moment of the element about this web of a larger width than height is smallest about that axis which lies parallel to the width of the web. Because of this directional dependence of the lowest bending resistance moment of the slotted cross sections and their spiral-shaped arrangement in the longitudinal direction of the element, in the region of a rotation of the helix about the element in each bending direction there is in each case a cross section with a small bending resistance moment. By way of the fact that the helical-shaped pattern is arranged several times about the element in the longitudinal direction of the element, the element is as a whole bendable in every direction.

With each torsion-loaded component the principle tension lines run spiral-shaped about the torsional axis. By way of the fact that the openings are arranged in a pattern helical-shaped in the longitudinal direction of the element, also the webs which have not been cut through are arranged helical-shaped and form a helical-shaped uninterrupted material region which is in the position of transmitting principle torsional tensions without being weakened.

The element preferably consists of a metallic material. Due to the variety of application possibilities in surgical technology, for example as an implant for the marrow nailing of the upper arm or as a bendable shaft for a marrow space drill, the element preferably consists of biocompatible material, in particular implant steel or titanium.

Tension and compressive forces can be transmitted essentially rigidly on account of the one-pieced form of

the element. By way of the dimensioning of the openings, in particular by the depth of the slots with the previously described embodiment form, the safety of the element against buckling may be set.

Embodiment forms of the invention are hereinafter described in more detail by way of the attached drawings.

Fig. 1 shows a lateral view of a cutout of an element for transmitting forces according to the invention.

Fig. 2 shows a lateral view of a cutout of a further element for transmitting forces.

Fig. 3 shows a section along the line X-Y through the elements in Fig. 1 and 2.

In Figs. 1 and 2 the same details or details corresponding to one another are indicated with the same reference numerals.

With reference to Figs. 1 and 2 an elongate element 2 for transmitting forces is formed as a tube with a tube outer diameter D and a tube thickness S. The walling 4 of the element 2 comprises slots 6 which with a width B and a depth T in each case transversally extend into the element 2. With this each slot 6 leaves a region 8 of the element, near to the edge, which is not cut through in the respective transversal cross section. The slots 6 are arranged next to one another at a distance to one another.

In Fig. 1 each slot 6b is formed displaced to the neighbouring slot at an angle of 90° about the longitudinal axis 10 of the tube. In Figure 2 the angle is 180°. By way of this the element 2 according to Fig. 1 is bendable about two axes which lie at right angles to the longitudinal axis 10 of the element 2 as well as at right angles to one another. The element 2 according to Fig. 2 is only bendable about one axis which lies at right angles to the longitudinal axis 19 of element 2. Both elements 2 according to Fig. 1 and 2 are for example the implant for bone marrow nailing the upper arm in that on introduction into the drilled out marrow space of the upper arm bone it may follow the curvature of this bone, which is determined by the anatomy.

In order to transmit torsional, tensile and compressive force and to be bending-elastic in bending axes perpendicular to the longitudinal axis, the element 2 may be proportioned as follows: the slots 6 have a distance A to one another of >5% and <40% of the tube outer diameter D. The slots 6 have a width B of >20% and <80% of the distance A to the neighbouring slot. The slots 6 are displaced to the neighbouring slot about an angle >20° and ≤180° about the longitudinal axis 10 of the tube. Each slot 6 extends with a depth T of <90% of the tube outer diameter D transversally into the element 2. The wall thickness S of the tubular element 2 is >5% of the tube outer diameter D.

Claims

1. A hollow elongate element (2) of elastic material for transmitting forces wherein the wall (4) comprises openings (6) which reduce the bending resistance moment and are arranged such that the torsion resistance moment of the element is essentially maintained.

2. The element for transmitting forces according to claim 1, wherein the element is cylindrical.

3. The element for transmitting forces according to claim 1 or 2, wherein the element is tubular.

4. The element for transmitting forces according to claim 1, wherein the openings (6) are arranged in a pattern recurrent in the longitudinal direction of the element (2).

5. The element for transmitting forces according to claim 1, wherein the openings (6) are arranged in a pattern helical-shaped in the longitudinal direction of the element (2).

6. The element for transmitting forces according to claim 1, wherein the openings are slots (6) which each extend transversally into the element (2) and of which each slot does not cut through a region (8) of the element, which is near to the edge, in the respective transversal cross section, and wherein the slots are formed offset to one another such that the regions (8) near to the edge are arranged helix-shaped in the longitudinal direction of the element (2).

7. The element for transmitting forces according to claim 6, wherein the element (2) is tubular and has a tube wall thickness (S) >5% of the tube outer diameter (D) and wherein each slot is formed offset to the neighbouring slot at a distance (A) of >5% and <40% of the tube outer diameter (D) and about an angle >20° and ≤180° about the longitudinal axis 10 of the tube and extends transversally into the element (2) with a depth (T) of <90% of the tube outer diameter (D) and with a width (B) of >20% and <80% of the distance (A) to the neighbouring slot.

8. The element for transmitting forces according to claim 1, wherein the element (2) consists of a metallic material.

9. The element for transmitting forces according to claim 1, wherein the element (2) consists of a biocompatible material, in particular implant steel or titanium.

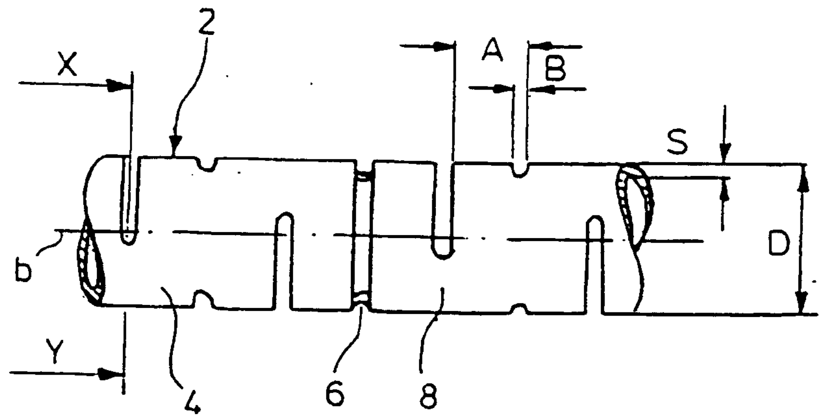

FIG. 1

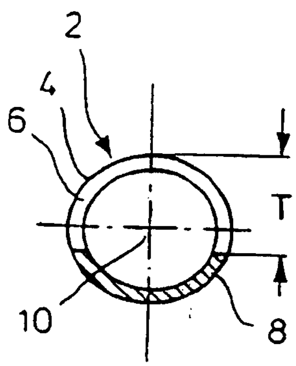

FIG. 3

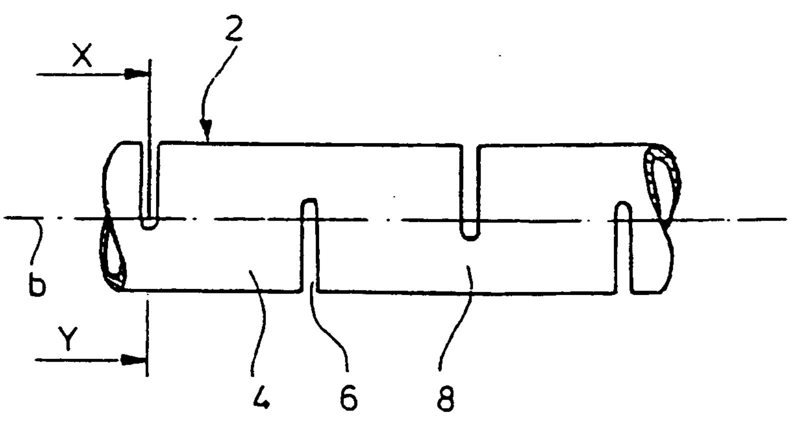

FIG. 2

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 889 252 A3

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
07.04.1999 Bulletin 1999/14

(43) Date of publication A2:
07.01.1999 Bulletin 1999/01

(21) Application number: **98109610.0**

(22) Date of filing: **27.05.1998**

(51) Int. Cl.[6]: **F16C 1/00**, F16C 3/00, A61B 17/16, A61B 17/72

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **02.07.1997 DE 29711559 U**

(71) Applicant: **Howmedica GmbH**
D-24232 Schönkirchen (DE)

(72) Inventors:
- **Harder, Hans Erich**
  24253 Probsteierhagen (DE)
- **Jensen, Harm-Iven**
  24214 Noer (DE)
- **Speitling, Andreas Werner, Dr.-Ing.**
  24105 Kiel (DE)

(74) Representative:
Patentanwälte
Hauck, Graalfs, Wehnert,
Döring, Siemons
Neuer Wall 41
20354 Hamburg (DE)

(54) **An elongate element for transmitting forces**

(57) A hollow elongate element (2) of elastic material for transmitting forces in which the wall (4) comprises openings (6) which reduce the bending resistance moment and are arranged such that the torsion resistance moment of the element essentially remains.

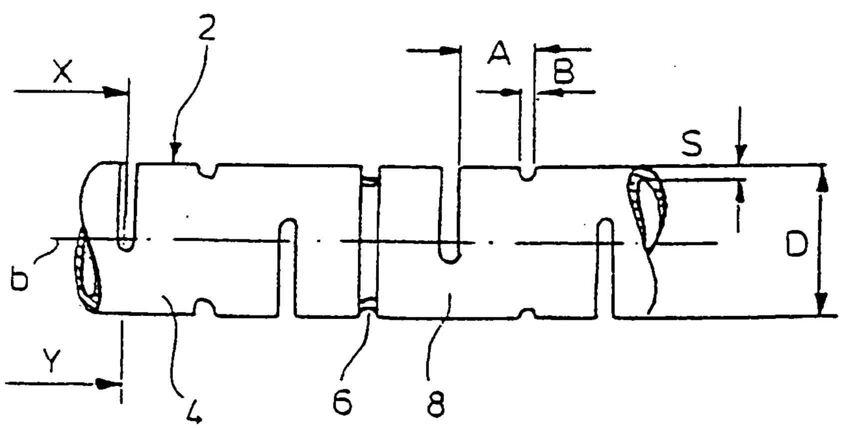

FIG. 1

EP 0 889 252 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 9610

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 669 105 A (SMITH & NEPHEW DYONICS) 30 August 1995 * column 3, line 29 - column 4, line 36; figures 2-4 * ---	1-9	F16C1/00 F16C3/00 A61B17/16 A61B17/72
X	EP 0 393 834 A (SHIBER SAMUEL) 24 October 1990 * column 4, line 36 - column 5, line 6; figures 3,4 * ---	1-6,8,9	
X	US 4 328 593 A (STRAUMANN FRITZ ET AL) 11 May 1982 * column 7, line 29 - column 8, line 62; figures 10-14 * ---	1-4,8,9	
A	EP 0 271 355 A (SCHWARTZMAN EVERETT H) 15 June 1988 * abstract; figures 2-8 * ---	1-4,7,8	
A	US 5 284 128 A (HART CHARLES C) 8 February 1994 * column 3, line 8 - column 4, line 59; figures 1-22 * -----	1-4,8,9	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F16C A61B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	11 February 1999	Fischbach, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 98 10 9610

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-02-1999

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0669105	A	30-08-1995	AU	1237395 A	31-08-1995
			CA	2143130 A	24-08-1995
			JP	7265325 A	17-10-1995
			US	5620447 A	15-04-1997
			US	5833692 A	10-11-1998
EP 0393834	A	24-10-1990	US	5007896 A	16-04-1991
			DE	69026860 D	13-06-1996
			DE	69026860 T	10-10-1996
			EP	0680730 A	08-11-1995
			US	5443443 A	22-08-1995
			US	4979939 A	25-12-1990
			US	5653696 A	05-08-1997
US 4328593	A	11-05-1982	CH	642250 A	13-04-1984
			DE	3006178 A	02-07-1981
EP 0271355	A	15-06-1988	US	4790700 A	13-12-1988
			JP	1055442 A	02-03-1989
			US	4913605 A	03-04-1990
US 5284128	A	08-02-1994	WO	9314690 A	05-08-1993

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82